REMARKS

Claims 1, 3, 6 and 27 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 102

Claim 1 is rejected under 35 U.S.C. § 102(b) as being anticipated by Allen et al. (U.S. Pat. No. 4,746,935). This rejection is respectfully traversed. Notwithstanding, Claim 1 is amended to recite the subject mater previously pending in claim 2. The office action acknowledges that Allen fails to teach this subject matter. Accordingly, Allen cannot anticipate Claim 1.

REJECTION UNDER 35 U.S.C. § 103

Claim 2 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Allen (U.S. Pat. No. 4,746,935) in view of Kitahara et al. (U.S. Pat. No. 6,328,395). Claim 3 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Allen (U.S. Pat. No. 4,746,935) in view of Minowa et al. (U.S. 2001/0002134). Claims 4 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Allen (U.S. Pat. No. 4,746,935) in view of Junhua (U.S. 2000/0085962). Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Allen (U.S. Pat. No. 4,746,935) in view of Takahashi (U.S. Patent No. 6,527,354).

Claims 2, 4 and 5 are cancelled. Accordingly, these rejections are moot.

Claims 3 and 6 depend from claim 1. Applicant respectfully submits that these claims are allowable for at least the same reasons as set forth below relative to claim 1.

Claim 1 calls for a method of controlling the driving of a function liquid droplet ejection head having a plurality of nozzle arrays disposed therein with a different function liquid droplet ejection amount per unit nozzle. In one print cycle, the driving of the plurality of nozzle arrays is controlled by using a single driving signal. The single driving signal includes a single micro oscillation pulse, a first ejection pulse, a second ejection pulse and a damping pulse.

The single micro oscillation pulse causes a function liquid forming a meniscus at each nozzle to oscillate without causing ejection of the function liquid. The first ejection pulse has a first waveform that corresponds to the specifications of a first nozzle array of the plurality of nozzle arrays to eject function liquid droplets from the first nozzle array. The second ejection pulse has a second waveform that corresponds to the specifications of a second nozzle array of the plurality of nozzle arrays to eject function liquid droplets from the second nozzle array. The single damping pulse damps residual oscillation of a pressure generating element which generates pressure fluctuations in a cavity communicating with each nozzle of the plurality of nozzle arrays.

In the one print cycle, the second waveform is different than the first waveform, the micro oscillation pulse is inputted before the first and second ejection pulses, and the damping pulse is inputted after the first and second ejection pulses. Also, the first nozzle array ejects a first function liquid droplet ejection amount and the second nozzle array ejects a second function liquid droplet ejection amount. The second function liquid droplet amount is smaller than the first function liquid droplet ejection amount.

One embodiment of the claimed invention is shown in FIG. 9 and described in paragraphs [0098] to [0111]. In one print cycle, the drive signal (COM) is made up of: a first pulse (the claimed micro oscillation pulse) which is inputted as a countermeasure against thickening of the function liquid; a second pulse (e.g., the claimed first ejection pulse) which is inputted to eject function liquid droplets from the small nozzle array 10b; a third pulse (e.g., the claimed second ejection pulse) which is inputted to eject function liquid droplets from the large nozzle array 10a; and a fourth pulse (the claimed damping pulse) which is inputted to damp residual oscillation of the pressure generating element (a piezoelectric element) 65.

The micro oscillation pulse is a single waveform in which only one waveform is inputted in one print cycle. A voltage that does not eject function liquid droplets from the respective nozzles 11a, 11b is applied to the micro oscillation pulse. The waveform of the micro oscillation pulse and the maximum potential thereof are determined according to the type of function liquid droplets. By inputting the micro oscillation pulse, the function liquid which forms the meniscus of the respective nozzles 11a, 11b is oscillated. As such, it is possible to prevent the function liquid in the vicinity of the nozzle orifice portion 52a from increasing in viscosity. Therefore, a good ejection state of the function liquid can be maintained.

Since only one waveform of the micro oscillation pulse is inputted in one print cycle regardless of the number of ejection pulses to be inputted later, the influence on printing throughput can be reduced. Namely, in the case of driving the two nozzle arrays 10a, 10b which have different function liquid droplet ejection amounts (caused by e.g., nozzle orifice diameters) per unit nozzle, the nozzle arrays are conventionally

driven by using independent drive signals (2COM), respectively. In such a case, micro oscillation pulses are required for each of the respective drive signals. However, in the claimed invention, the two nozzle arrays 10a, 10b which have different function liquid droplet ejection amounts per unit nozzle are driven by using a single drive signal. Thus, a common drive signal can be shared therebetween, which results in a shortening of the print cycle (and an improvement in the printing throughput). Moreover, the micro oscillation pulse is inputted before the ejection pulses to be described later. Thus, at the time of inputting the first ejection pulse, a normal function liquid which is free from thickening can be ejected.

The first ejection pulse is a waveform inputted to eject function liquid droplets from the small nozzle array 10b. The second ejection pulse is a waveform inputted to eject function liquid droplets from the large nozzle array 10a. The waveforms of the first and second ejection pulses are selected in accordance with the specifications of the respective nozzle arrays 10a, 10b. Thus, it is possible to use nozzles having various specifications (nozzle orifice diameter, shape and the like). In addition, function liquids of various weights or viscosities can be ejected.

The damping pulse is a waveform inputted to damp the residual oscillation of the pressure generating element 65. The waveform and the maximum voltage value of the damping pulse are determined in accordance with the waveform of the last inputted ejection pulse. By inputting the damping pulse, it is possible to damp or weaken the residual oscillation of the pressure generating element (piezoelectric element) 65 which may remain after the last ejection pulse is inputted. The input of the damping pulse

makes it possible to always perform stable ejection of the function liquid without imposing influences of the last ejection pulse on the next drive signal.

It should also be noted that the micro oscillation pulse and the damping pulse are applied to each nozzle of the plurality of nozzle arrays. In contrast, the first ejection pulse is only applied to the first nozzle array of the plurality of nozzle arrays. Likewise, the second ejection pulse is only applied to the second nozzle array of the plurality of nozzle arrays.

The prior art fails to teach or suggest the subject matter of claim 1. Accordingly, claim 1 and all claims depending therefrom should be in condition for allowance.

NEW CLAIM

New claim 27 is added herein. The subject matter of claim 27 was previously pending in claim 1. No new matter is added.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner

believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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By: _____
G. Gregory Schivley
Reg. No. 27,382
Bryant E. Wade
Reg. No. 40,344

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1600

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